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PROCESSES OF ORGANIC EVOLUTION[1]

By Professor R. RUGGLES GATES

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OMITTING the Greek philosophers and the adumbrations of the early naturalists, the first thorough-going theory of evolution may be said to be that of Lamarck. In his time, however, even the elements of physical and chemical science were in a rudimentary state, so that the nature of organic structure and functioning was but little understood. His theory of the direct impress of adaptive modifications on the organism and their transmission by inheritance to future generations failed to convince the world at large of the fact of evolution and has since failed of acceptance by critical students of evolutionary processes. Darwin partly accepted this principle of the inheritance of acquired characters, which was only natural, considering the very sketchy and inadequate knowledge of the nature of reproductive processes in plants and animals in the middle of the nineteenth century, when the "Origin of Species" was written. It may even yet find support in some subtler serological form.

Darwin, however, stressed his principle of natural selection as the main force causing evolutionary adaptation. This theory was derived in turn from an extension of Malthus's law of human populations, and still stands as an almost universally accepted process in the modification and replacement of species. But evolutionists still differ widely in the emphasis they would lay on natural selection in comparison with other evolutionary processes. Darwin relied upon the selection of variations of all kinds occurring in large numbers in the species, but in his time very little was known either of the nature of these variations or the manner of their inheritance. Had Mendel's paper on

[1] Substance of a lecture at the University of California, Berkeley, November 27, 1940.

the inheritance of particular characters as units come to his notice, no doubt he would have recognized its fundamental importance; but we may doubt whether it would have greatly altered his views regarding the nature and importance of the process of natural selection.

To Darwin, evolution was essentially an observational science, although he incorporated into his views the results of breeding many domesticated animals and plants. It was deVries who made evolution an experimental science. At the turn of the twentieth century his mutation theory not only embodied an enormous amount of breeding work with many plants, but it drew a clear and fundamental distinction between inherited mutations and non-inherited fluctuations. This distinction holds to the present day, and serves as a practical criterion of a mutation.

The discovery of the Oenothera mutations by deVries was followed by their analysis (Gates, 1915) in terms of different kinds of chromosome change. The first cases of non-disjunction were observed in Oenothera before trisomic mutations were known. Then followed the discovery in Oenothera of the first triploid, tetraploid and trisomic mutations, while such forms as *Oenothera brevistylis* and *O. rubricalyx* were recognized as gene mutations. This was the beginning of polyploidy or the occurrence of chromosomes in multiple series, the importance of which in evolution can be realized from the fact that half the species of flowering plants are now believed to fall into polyploid series. Not only is polyploidy an important factor in tracing the phylogeny of a genus and the relationships between its species, but with recent cytological methods the nature and significance of the change in basic number from one genus to another can also be investigated.

In the meantime the genetical work with Drosophila had begun in 1910 and in later years the Morgan school found occurring in Drosophila all the types of chromosome change which had previously been discovered in Oenothera. The main evolutionary contribution of Morgan and his associates was the remarkable analysis of the mutations occurring in Drosophila (a small organism which could be intensively studied) and the manner of their inheritance. That fundamental analysis became progressively more intimate in terms of the chromosomes over a long period of years. It was further facilitated by the discovery of Muller in 1927 that by the action of x-rays on the germ cells the mutation rate could be speeded up 150 times, and later by Painter's discovery (1934) that the bands on the gigantic chromosomes in the salivary gland cells of the larvae constitute a visible record of the genic condition at the various loci in each chromosome.

These and other striking advances in the analysis of chromosome structure, combined with the identification of genic loci in the salivary chromosomes of insects, have brought us much nearer to an understanding of the nature of genic differences. The conception of the gene has undergone various changes, but running through the genetic literature has been the general conception that all the genes in a chromosome were fundamentally alike as regards their size and structure, whether this was conceived as a single molecule or a more or less highly organized group of molecules. I have never accepted this view and have frequently spoken of *genic differences* arising within the chromosome but representing changes of quite different kinds. In a paper (Gates, 1915) on heredity and mutation as cell phenomena I pointed out that what afterwards came to be called genes represented merely *differences*, the origin of which constituted a mutation.

At the time when my "Mutation Factor in Evolution" was written (1915) it was necessary to construct a definition of a mutation on the basis of contemporary knowledge. The mutations studied up to that time were chiefly color differences, as in the coats of animals or the petals of flowers. It seemed possible that all mutations represented a basically chemical change. After cogitating long on the subject, the conclusion was reached, on very general grounds, that probably physical as well as chemical changes occurred in the chromosomes, and the definition (p. 293) was constructed as follows: "A mutation is a discontinuous germinal change arising from a physical or chemical alteration . . . in one or both of the germ cells . . . which produces a new individual." It appears now that the very large majority of so-called gene mutations are physical changes—deletions, inversions, translocations and minute rearrangements within the chromosomes. And so it has become a question whether any gene mutations, even the color changes, are the result of a chemical change in the germinal material. Indeed, the distinction between physical and chemical changes in the protein compounds appears to be breaking down.

The orthodox view that the genes in a chromosome are bodies of similar size and nature like beads on a string has never appealed to me. Obviously, whatever view we take of the structure of the axis or core of the chromosome will be of fundamental significance. It is important to know when and how chromosomes became thread-like bodies which split lengthwise. Evidence on this point was obtained in a study of cell division in the Cyanophyceae, made in my laboratory by Spearing (1937). The primitive nuclei of these simple organisms show a variety of conditions. In the genus Oscillatoria three species all showed different conditions, ranging from simple constriction or amitosis in one species to chromosome-like rods which

divide transversely in another. After each division these rods grow in length. They must evidently be longitudinally undifferentiated, but they are presumably the progenitors of true chromosomes which divide longitudinally only.

It is difficult to believe that the numerous chromosomes found in many of the Protozoa are differentiated along their length, like the chromosomes of higher plants and animals, although in some Protozoa they show remarkable morphological differentiation from each other. It seems reasonable to suppose that these chromosomes are chemically differentiated from each other but are only beginning to be differentiated along their lengths. How the development of the mitotic mechanism led to a change from a transverse to a longitudinal "split" in these bodies is unknown, but we may reasonably picture the longitudinal differentiation of the chromosomes as gradually taking place by mutations of various kinds after the evolution of the mitotic process was complete. It is clear that the mitotic mechanism was evolved in the unicellular stage of organization. Once the longitudinal division of the chromosomes had been stabilized, this made possible the subsequent differentiation of the chromosomes along their length. Different sections of a chromosome could undergo mutational changes in the axis of protein molecules, until some at least had been reduced to minimum size (Gates, 1932). If the axis of the chromosome consisted simply in a chain of protein molecules and mutations consisted in some rearrangement of the side chains along the molecule, then the distinction between a physical and a chemical change would disappear or be only a matter of magnitude of the change. But probably the core of the chromosome, which is duplicated in each cell division, is more complicated than this. The cyclol hypothesis of Wrinch indicates that these protein chains are folded into a basket work which under some conditions can unfold again through breakage of certain bonds.

The view of the "gene" here presented seems to have much in common with that of Goldschmidt (1938). Whereas in my view so-called genes represent differences or differentiations of many kinds, both physical and chemical, along the axis of the chromosome, Goldschmidt would abolish the gene altogether and accept the entire chromosome as a unit presumably containing in its axis a single protein molecule stretching continuously in a spiral from end to end. I am constrained from going so far mainly by the fact that mutations are repetitive, precisely the same mutation occurring repeatedly at the same locus of a chromosome and by the phenomena of crossing-over. This seems to show a greater stability of the chromosome axis and a greater fixity of its parts than would be possible in a structure which is equally subject to physical and chemical change at every point along its length.

Goldschmidt has followed up his stimulating views regarding the way in which the genic material is disposed in the chromosome by a full-dress theory of evolution based partly on those views. In his recent book, "The Material Basis of Evolution" (Goldschmidt, 1940), he has discussed the nature of variations with reference to a wide range of material, mainly zoological, much of it based on his own extensive observations and experiments. Particularly in connection with the gypsy moth, *Lymantria dispar*, and other organisms, he has accumulated over many years a vast body of organized results, which are effectively used in coordination with a wide range of other work to set forth a new view of the evolutionary significance of different kinds of variations.

Briefly, we are first confronted with evidence which is interpreted to mean that gene mutations produce intraspecific varieties and geographic subspecies which enable a species in its spread to adapt itself to local niches and microclimates, but which never overstep the bounds of the species and are therefore of no evolutionary or phylogenetic significance. The abundant evidence of geographic variation is brought to bear and the conclusion is reached that geographic races are not incipient species and that all such variation comes to a dead end; it is microevolution on a genic basis, but it is all wiped away from time to time, and never by any chance accumulates so as to participate in the formation of a new species. Microevolution is a series of episodes which have no phylogenetic significance.

It seems to me that this extreme view, which eliminates all evolutionary value from the neo-Darwinian or neo-mutationist process, is only reached by placing undue stress on interspecific sterility as a criterion of species. Lions and tigers will cross, but I can not imagine any zoologist who would conclude that they must therefore be placed in one species. I can see no reason for cutting off all the micromutations or small genic differences from having any part in specific differentiation. This can only be done by overemphasis on interspecific sterility and also by misinterpreting its role in the differentiation of species. In the genus Oenothera, the subgenus Onagra contains some 75 recognized species which are all fertile with each other, yet even the most extreme "lumper" among taxonomists would never agree to combine them into one species. The range of forms included in this group shows the widest variation in almost every character except those which are of generic value. To call them all one species would be to reduce taxonomy to an absurdity. The conception of the Victorian naturalists that interspecific sterility was an essential

criterion of species is more honored in the breach than in the observance. It has, I think, become evident that sterility is a more or less accidental condition which may arise early or late in the differentiation of particular species.

There is another basic point about the origin of sterility between organisms. It is clear (Gates, 1938) that sterility between two strains can arise by a chromatin rearrangement in one of them, such as an interchange, reversal, deletion or duplication. We know further that these changes can arise as single mutational changes in a chromosome. This may or may not be accompanied by a "position effect" or phenotypic difference, but even if it is not it may produce partial sterility with the parent form. It will thus set up a sterility barrier which will lead to these strains diverging further in their descendants. The old conception of sterility was that it only arose when two strains had diverged sufficiently widely from each other, but the newer results show that chromatin rearrangements can occur leading to immediate partial sterility. Phenotypic divergence of the strains thus isolated from each other will only occur later through differences in the mutations which arise in the two lines of descent. It appears therefore that interspecific sterility is not necessarily a result of previous divergence but may arise through a mutation and be the primary cause of subsequent divergence. In other words, it appears that in many cases interspecific sterility is not a consequence of a long period of specific differentiation, but is rather the primary condition which makes subsequent divergence possible. This is quite different from the generally accepted view of the origin and role of intersterility, but there is a large amount of recent evidence in plants and animals which is most naturally interpreted in this way.

If I may return to the brilliant speculations of Goldschmidt (1940), he draws a sharp line between micro-evolution, which always leads to a blind alley, and macro-evolution, which he conceives to be the real evolutionary process, based on rearrangements of the chromosome material. He has himself investigated several cases in Drosophila in which there appears to have been an epidemic of mutational change giving rise to several new mutant types at once. None of these, however, so far as I am aware, have produced a new species at one stroke. But they appear to be the basis of Goldschmidt's impressive theory that new species arise solely by a repatterning of the chromosome, which he calls a systemic mutation. All species are to be considered then as arising by single large steps or macro-mutations, quite in accord with the original conception of deVries, only the transformations must all be large and of the nature of jumps rather than steps.

If one may venture to criticize this position, it may first be said that it seems impossible to draw any sharp line between the two categories of micro- and macro-mutations. Various typical gene mutations are now known from the study of the bands in the salivary chromosomes of Drosophila to be the result of minute deletions or duplications, and many other Mendelian differences are suspected of having arisen by minute rearrangements in a short section of a chromosome. Reversals of a segment of a chromosome are known to be of various lengths, just as are deletions, so that chromosome rearrangements can not be placed in separate categories of large and small. It seems to me, therefore, that the basis for a sharp distinction between macro- and micro-evolution breaks down. Goldschmidt supports the distinction by laying an emphasis on interspecific sterility which in my opinion it will not bear.

In one respect, however, my views differ from those of Goldschmidt less than might appear. I have always been fascinated by the possible evolutionary value of monstrosities and large "teratological" mutations and have made considerable collections of data bearing on this subject. I have often cited such cases as the possible basis for the origin of a new genus or even a new family of plants. Such mutations are often regarded as teratological simply because they are rare and differ widely from the type. We may briefly consider two such instances. The capitulum or head of flowers which characterizes the Compositae, as in a sunflower head, may have originated by a single step, from an umbel by elimination of the floret stalks or from a raceme by telescoping of the axis, according to which morphological view of the structure we accept. It seems more reasonable to assume that it happened at one or two strokes than that it occurred gradually through a series of stages. Compact heads have appeared independently in such genera as Parkia and Trifolium (Leguminosae) and Platanus (plane tree). The advantages of the condensation of the flower cluster in relation to insect visits are such as would lead to its rapid spread through natural selection once it had arisen as a teratological monstrosity.

As a second instance let us take the genus Aquilegia of the Ranunculaceae. It has five petals, all with long spurs containing nectar—a typical case of peloria nectaria. Linnaeus observed and described the first case of peloria in the toadflax, *Linaria vulgaris*. Like various other members of the Scrophulariaceae and other families, the zygomorphic flower sometimes loses its spur and so becomes radially symmetrical. This is peloria anectaria, and the condition is inherited, as

shown particularly by the experiments of deVries. But peloria nectaria also occurs as a rare mutation in Linaria and other genera. What more natural than that a one-spurred ancestor of Aquilegia should undergo a peloric mutation, producing a flower with the five petals all bearing spurs? Indeed, it is very difficult to imagine how a flower with one spurred petal could give rise to one with five spurred petals by a series of mutational steps, in each of which a balanced type of flower with survival value was produced.

I am therefore a confirmed believer in the evolutionary importance of large mutations. The changes in basic chromosome number which we frequently find in passing from one genus to another appears to represent a condensed series of events resulting shortly in a new balance of the chromosomes. This serves as the stable starting point for a new genus, in which other mutational processes of various kinds will then proceed to produce a series of new species or even a whole sub-family, as in the Pomoideae. Amphidiploidy, now known in so many wild species of plants, is a method by which a new species arises by two marked steps, one of which is a mutation.

From such considerations it seems impossible to separate macro- from micro-evolution. Both must have played their part, since gene mutations occur in the same line of descent in which chromosome rearrangements have taken place. Evolution is a very multiform process. Mutations may be of any size, from minute differences only demonstrable by statistical methods to large mutations and chromatin rearrangements and finally to "hopeful monsters." Each group of organisms has moreover its own evolutionary problems and principles, depending on its ecology and its reproductive methods.

My views differ from those of the neo-Darwinians in assuming that wide jumps occur as well as the small mutations of recent Mendelian work. I differ from the macro-evolutionists in assuming that the small mutations as well as the large ones have evolutionary significance. This brings my position in some respects much nearer to that of deVries in the original statement of his mutation theory.

THE RELATION BETWEEN PHYSICAL AND MENTAL DEVELOPMENT

By Professor FRANZ BOAS

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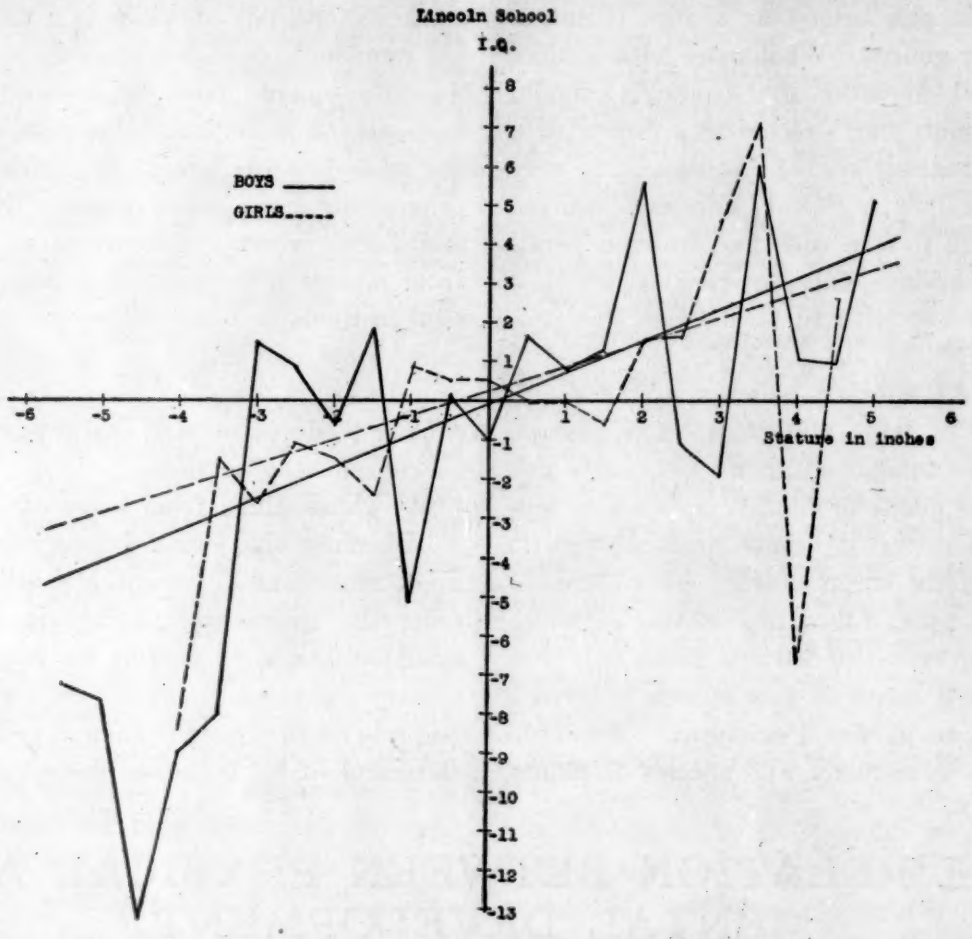
UNTIL recent years anthropological investigation has proceeded on the assumption that populations are stable. The significance of the increase of stature during the past century, which has been known for a long time, has been assumed to be the effect of bettered social conditions without leading to the question in how far other bodily features may be affected. Selection has been considered as leading to differentiation of social or local groups, but actual physiologically determined changes have hardly been considered at all. In other words, the form of the human organism has been considered as entirely determined by hereditary causes. In 1910 I was able to show that the proportions of the body are not stable, but that, taking a population as a whole, children differ in bodily form from their parents. These data have been vigorously contested, although a simple consideration shows that every organism must bear the impress of its environment and that an absolute form without environment does not exist. I believe this view is now fairly generally accepted, particularly after Dr. Shapiro's corroborative studies on the differences between Japanese born in Japan and their descendants born in Hawaii, and Bowle's studies of Harvard students and their descendants.

The observed changes in proportion of the body have led to the problem of the interrelation between these changes. Every change of proportion indicates that the rates of change of the measures involved are unequal. It is not possible at the preesnt time to study the reaction of a given anatomical type to various environmental conditions, and there is little hope that the problem can be solved by this method. It seems more promising to study the interrelation between tempo and rates of growth and development of various parts of the body, because these will determine the ultimate proportions of the adult. The investigations of constitution and of the effects of internal secretion upon growth indicate where we have to look for modification of bodily proportions. Anthropometric investigations relating to the tempo of development will throw light upon our problem. It has been known for a long time that during adolescence there is a rapid increase in the rate of growth. This occurs in both sexes, in girls nearly two years before it takes place in boys. So far as we know the whole skeleton participates in this change of tempo of growth, but not in equal amounts. The extremities grow more quickly than the trunk until adolescence, while later on the ratio is reversed. The size of the head has its most rapid growth in very early years. The development of teeth follows different laws. The age at which

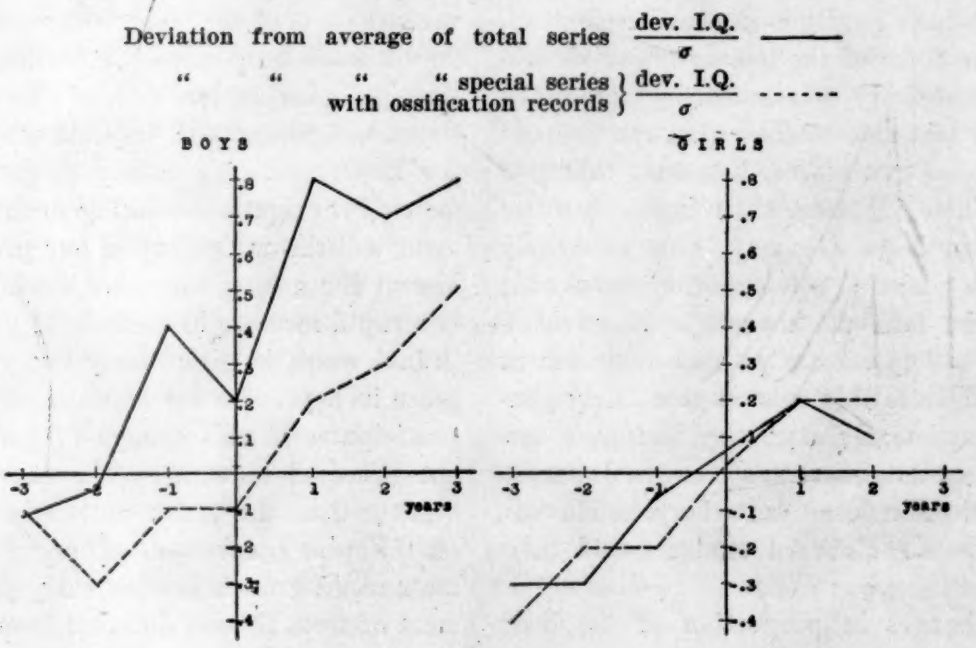
Relation between stature and I.Q. in terms of the deviation from average I.Q. determined by deviation of stature.



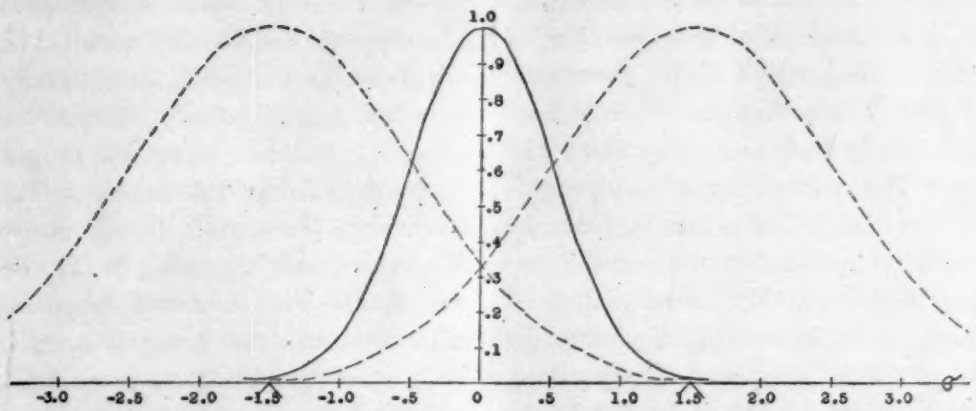
the same stage of tooth development is reached by boys and girls differs not by two years, as does the skeletal growth, but by a few months only. I showed also in 1912 that the accelerated development of girls which brings it about that the rapidly growing parts of their skeleton equal or exceed the corresponding measures of boys hides the sexual differences in size which exist from birth on. These appear clearly in all slow-growing parts of the skeleton.

The general problem can not be solved by a study of size. We have to extend it so as to include the relations of physiological functioning to anatomical structure since the form depends largely upon physiological conditions. As a further step it should be correlated with psychological observations. Crampton studied in 1908 the time of appearance of pubic hair. In 1912 I investigated the tempo of physiological development by observations on the time of appearance of a number of features, such as ossification of epiphyses, time of minimum and maximum rate of growth,

Relation between I.Q. and ossification of radius in terms of the deviation from average I.Q. determined by deviation of x-ray age.


Deviation from average of total series dev. I.Q. / σ
" " " " special series with ossification records dev. I.Q. / σ
BOYS
GIRLS
years
years

Variability of family lines and fraternities
Lincoln School



eruption of teeth, menarche and menopause and found a very rapid increase of the variability of the tempo of development. During the last few years it has also been shown repeatedly that the tempo of physiological development has increased. From material kindly placed at my disposal by Dr. Milo Hellman, it appears that the eruption of teeth has been accelerated by five months from 1915 to 1925. Dr. Michelson has found an acceleration of four months from 1930 to 1938 in the menarche. Throughout, these investigations have proved that the tempo of physiological development is closely related to anatomical growth, so much so that it has been suggested that physiological age should be substituted for chronological age. This, however, is not justifiable, because the average child, let us say of twelve years, is not equal to the ten year old with an acceleration of two years. Furthermore, the degree of acceleration in regard to one feature, for instance sexual maturity, does not influence skeletal development as strongly as the time of maximum rate of growth; and the same is true in regard to eruption of teeth and skeletal growth.

Data in regard to the relation between bodily and mental development are very scanty. Most suggestive are the observations of Shuttleworth of 1938 on the relation between mental age and period of maximum growth. During the past year I studied under a grant from the Carnegie Corporation the relation between skeletal growth and development and the intelligence quotient. Although I am fully conscious of the limited significance of the intelligence quotient, it may be said that it is an expression of maturity and of intelligent use of experience, and in this sense significant in a group that has essentially the same range of experience. The material was obtained from Lincoln School with the generous help of Dr. Gertrude Hildreth; measurements and x-ray films of hands and wrists were made by Dr. N. Michelson and Dr. W. Nussbaum, the calculations were made by Dr. D. Trachtenberg. A study of the data collected shows an unexpectedly high relation between intelligence quotient and stature. Children short for their age had an intelligence quotient markedly under the norm, those tall for their age, one above the norm. The groups short and tall contain a hereditary element that is probably less pronounced in the tempo of ossification. The latter shows the same type of relation to the intelligence quotient. Retarded children have a lower intelligence quotient than those accelerated. This corroborates the inference drawn by me from Porter's early observation. He found that children of the same age are the taller the higher the grade they had attained in school. In other words, their physical and mental development went hand in hand. The close correlation between anatomical and psychological traits in childhood must be interpreted as due to the influence of the tempo of physiological development over the body and its functions. The important question remains open whether in the further course of life, when the variations in tempo become greater and greater, similar relations may be found. Unfortunately we have no data on this subject. The available observations certainly do not prove that normal bodily traits that are not affected by acceleration or retardation have any effect upon mental status.

I have also investigated the question in how far heredity may be expressed in the results of our investigations. I have repeatedly pointed out that the coefficient of correlation which is often used to express hereditary resemblance is merely an expression of the heterogeneity of a population. It is readily seen that when in a large population all families were of the same character it would be impossible to identify a child by its resemblance with its own parents, because all the parents would be alike. The correlation would be zero. If on the other hand all the families are very diverse, the similarity between children and parents will be apparent. The more diverse the families, the greater will be the correlation between siblings. It follows from this that the greater the inbreeding in a

population, the lower the correlation between members of the family. I have demonstrated this by studies of city populations and small inbred communities.

We may consider every individual as a member of the fraternity to which he belongs. The fraternity represents a family line. The whole population consists of many distinct family lines and every family of a group of siblings. The variability of siblings is determined by heredity, that of the family lines by the degree of inbreeding in the population and the diversity of the constituent lines. My investigations of New York populations from this point of view gives for all the traits investigated, tempo of development, head form, and mental development as expressed by the intelligence quotient very nearly the same relation between the variability of family lines and that of fraternities, the latter being very nearly one half of the former. This value has been found not only in the selected New York groups, such as Horace Mann School, Lincoln School, Hebrew Orphan Asylum, etc., but also for the so-called European races. To realize the importance of this result I have indicated in a diagram the distribution of family lines and overlaid it with the variability of the fraternities for those family lines that stand on points one and one half times the standard deviation of the family lines below and above the norm. It will be seen that very few of the individuals belonging to the two sets of fraternities are equal. This is one of the strongest proofs showing that it is an utter error to ascribe the same qualities to a whole population—too often called a race. The genetic lines composing a race are so varied that the assumption that all members are by heredity endowed with the same physiological and mental characteristics is as absurd as to claim that they are all physically alike.

OBITUARY

SAMUEL HENSHAW

SAMUEL HENSHAW was born in Boston on January 29, 1852, and died in Cambridge on February 5, 1941. Of an old Boston family, he was the son of Joseph Lyman Henshaw and Jane Paine Henshaw. He had a sister, Elizabeth Lyman Henshaw, who died on October 24, 1926, and a brother, Joseph Putnam Bradlee Henshaw, who died on October 11, 1930. Samuel Henshaw married Miss Annie Stanwood on April 28, 1886. She died on March 12, 1900. Her death was a desperate blow that radically changed all his subsequent life.

Henshaw went to the Chauncy Hall School and the Boston Latin School. He did not go to college, but received an honorary A.M. from Harvard in 1903.

Henshaw was short in stature; but very strong. He had wonderful eyesight so that he could read the finest print and he never wore glasses, even in his old age. He had a very keen and critical mind in affairs and in his relations with men. This gave his judgment great weight with his associates. The keynotes of his character were his sensitiveness, his sense of fun, his personal integrity and his devotion to his work and his friends.

Primarily an entomologist, he had wide knowledge in other groups of animals, and his knowledge of scientific literature was both very great and very accurate. This helped him greatly to his editorial work, which was very extensive throughout his active years. He was gifted with a singleness of purpose and an intense application to work that are rarely equalled.

All his life interested in natural history, he became a member of the Boston Society of Natural History in 1871. In 1876 I first find record of his working on the collection of insects in the society. From that time on, until 1891, Henshaw was working at the Boston Society as assistant to Professor Alpheus Hyatt. While insects were his primary interest, he worked on various groups of invertebrates and vertebrates as well, and assisted Professor Hyatt greatly in preparing material for his courses in the Teacher's School of Science, a department of the Lowell Institute.

In 1892, Henshaw became secretary and librarian of the Boston Society of Natural History, which position he held until 1901, when he was succeeded by C. F. Batchelder, and a year later by Glover M. Allen.

In 1891–1898, Henshaw was part-time assistant in entomology at the Museum of Comparative Zoology, succeeding Dr. H. A. Hagen, who had retired on account of illness. From 1898–1903 he was assistant in entomology and librarian of the Museum of Comparative Zoology. From 1903–1911 he was curator of that museum, when his title was changed to director, and this position he held until November, 1927, when he was succeeded by Dr. Thomas Barbour. From 1927 his title has been director of the University Museums and of the Museum of Comparative Zoology Emeritus.

Henshaw was a fellow of the American Academy of Arts and Sciences, member of the American Society of Naturalists and American Society of Zoologists. He was one of the founders of the Cambridge Entomological Club, which started publishing *Psyche* in 1874, and for a time he edited that journal.

While secretary of the Boston Society of Natural History, he edited their publications and during at least a large part of his connection with the Museum of Comparative Zoology, he edited the publications of

that institution. As an editor, he was most painstaking, careful and exact.

When I first knew Henshaw, he lived in Mercer Circle, Cambridge, and later I became his opposite neighbor in Fayerweather Street. He was essentially a gentleman of the old school, with all the refinement and courtesy that that term implies. This in spite of a "crust" that often hid his finer feelings. These finer feelings were expressed in his devotion to his close friends, especially Dr. H. A. Hagen, Mr. Samuel H. Scudder and Dr. Henry P. Walcott, notably in the years of their invalidism. Among others to whom he gave his great loyalty and devoted interest were Professor Alpheus Hyatt, Dr. George L. Goodale, Walter Faxon and Mr. Alexander Agassiz. He frequently visited Dr. Goodale, and after the latter's death he sent to his widow lilies of the valley every Christmas as long as she lived. His sympathy went out especially to children, whom he dearly loved, and he entered into their joys with a spirit of comradeship that won their deep love and admiration. He planned with children trips to the circus or a sleigh ride or to the theater, when he was the life of the party. He was very fond of animals as pets, especially dogs, and any one who would abuse a dog roused his wrath. Personally very generous, he hated all meanness, sham or hypocrisy with a violent detestation.

During his later years, when crippled by arthritis and much of a recluse, his close friends, Dr. Alfred M. Tozzer, of the Peabody Museum, and Miss Gertrude A. Thurston, his former secretary at the museum, gave him most devoted care.

Henshaw did not publish extensively, and his principal publications were on insects. Dr. P. J. Darlington, of the Museum of Comparative Zoology, kindly gave me a very complete list of his publications: 1885, List of the Coleoptera of America North of Mexico, American Entomological Society, 161 pages, of which he published supplements in 1887, 1889 and 1895. He also published, 1889–1896, a bibliography of the more important contributions to American economic entomology in five parts, over 700 pages, Washington, U. S. Dept. of Agriculture, Division of Entomology, and, in 1898, The Entomological Writings of George Henry Horn, Transactions of the American Entomological Society, pp. xxv–lxxii. Besides these, he published some thirty other papers, mainly on insects, also obituary notices of his close friends, Dr. H. A. Hagen, Professor Alpheus Hyatt, Roland Hayward and Walter Faxon, and as well his annual reports in the Museum of Comparative Zoology.

Besides his natural history work, Henshaw was essentially a bibliophile and did an immense amount in building up to completeness the libraries with which he was connected. In addition, he had been acquiring for long years a very extensive collection of Gilbert White's "Natural History of Selborne." Many years ago he told me that he had over 100 editions of that work. Mr. Thomas Franklin Currier, of the Widener Library at Harvard, writes me: "I feel certain that nowhere else is there gathered together so complete and comprehensive a collection of materials relating to the author of the 'Natural History of Selborne,' embracing not only books and pamphlets, but manuscripts, prints photographs . . . and Henshaw did not stop with mere collecting; he knew the inside of his books. . . . A fairly complete scientific bibliography of White could probably be made without going out of the Henshaw collection." This great White collection, with his other books and manuscripts, Henshaw in his will left to the Bodleian Library at Oxford, with the feeling that as an English work it most properly belonged there.

ROBERT T. JACKSON

PETERBOROUGH, N. H.

DEATHS AND MEMORIALS

DR. EUGENE DAVENPORT, emeritus professor of thremmatology and emeritus dean of the College of Agriculture of the University of Illinois, died on March 31 in his eighty-fifth year.

DR. HERBERT FREUNDLICH, distinguished service professor of colloid chemistry in the Graduate School of the University of Minnesota, and formerly professor of colloid chemistry in the University of Berlin and assistant director of the Kaiser Wilhelm Institut für Physikalische Chemie und Electrochemie in Berlin-Dahlem, died suddenly on March 30.

DR. JOHN AHLUM SCHAEFFER, since 1935 president of Franklin and Marshall College, Lancaster, Pa., previously vice-president and director of research of the Eagle-Picher Lead Company at Joplin, Missouri, died suddenly on April 6 in his fifty-fifth year.

FREDERICK HUBBARD SIBLEY, professor of mechanical engineering and dean of the college of engineering of the University of Nevada, died on April 2 at the age of sixty-nine years.

DR. I. NORMAN BROOMELL, since 1918 dean of the School of Dentistry of Temple University, died on March 23. He was eighty-three years old.

THE death is announced of Dr. F. A. P. Aveling, professor of psychology at King's College, the University of London, at the age of sixty-five years.

AN Associated Press dispatch dated from Washington on April 2 states that a bill to designate each February 11 as a national holiday in honor of the birthday anniversary of Thomas A. Edison has been approved by a subcommittee of the House Judiciary Committee and has been submitted to the full judiciary committee for its consideration.

SCIENTIFIC EVENTS

THE COMMONWEALTH SOLAR OBSERVATORY, CANBERRA[1]

THE first report of the present director of the Mt. Stromlo Observatory refers to the period May, 1939–April, 1940, though it also sketches the history of the observatory since its establishment in 1910, and gives a brief account of the main observational programs carried out since the first director's appointment in 1924. The observations of solar radiation begun in 1926 have been completed, and a discussion of the results is promised. One of the most interesting conclusions is that the correlation between total solar radiation and duration of bright sunshine is so close as to be useful for derivation of the first quantity, the direct observation of which is difficult, from the second, which is a standard meteorological datum. Spectrohelioscopic and visual observations of the sun have been directed respectively to the detection and mapping of bright solar eruptions, several spectrograms of which have been obtained during 1939. As compared with flash spectra, these show a puzzling enhancement of low-excitation Fe I and Fe II lines.

A new program of stellar observations is planned for the Reynolds 30-inch reflector which has been converted from Newtonian to Cassegrain form for the purpose. A single-prism spectrograph for spectroscopic parallaxes and a photo-electric photometer have been made for use at the Cassegrain focus. The work on cosmic radiation and atmospheric physics with which the name of the observatory is especially associated has been carried on with a few modifications, chief among which are the discontinuance of the observations of atmospheric electricity and night-sky luminosity, and an extension of the work on cosmic rays and the ozone content of the atmosphere. With the establishment five miles away of an official Commonwealth meteorological station, many of the routine meteorological observations have been discontinued, though measurements having a direct bearing on other observatory programs are still being carried out. An impressive list of papers published during the year shows that the establishment is more than maintaining its high standing amongst southern hemisphere observatories.

THE PACIFIC EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

ACCORDING to a preliminary report on the program of the American Museum-Pacific Expedition which is now conducting field research along the Pacific coasts of Colombia and Ecuador, received by the American Museum of Natural History from Dr. Robert Cushman Murphy, curator of oceanic birds, the winter range, hitherto unknown, of several species of sea-birds has been established.

Dr. Murphy is leader of the expedition that has been in the northern Pacific aboard the diesel schooner *Askoy* since February, studying the relationship between the ocean waters adjacent to this part of South America and the life of the sea and the shore.

This area of the South American coast is one of the least known in the whole world as it is far from the regular trade routes and seldom visited by ships. It has been found that this region has a totally different current and temperature system from that of any other part of the Pacific Ocean adjoining South America and its life is correspondingly distinct. The field studies include basic oceanographic investigations, quantitative measurements of the microscopic life in the sea and study of the birds, fish and other animal life that depend upon this particular oceanic pasture for their existence.

The personnel, in addition to Dr. and Mrs. Murphy, includes Dr. John C. Armstrong of the department of living invertebrates, and Mr. José G. Correia, field assistant. Dr. Armstrong is making extensive oceanographic studies and Mr. Correia is collecting sea birds. To further the survey, extremely valuable scientific equipment was lent by the Hydrographic Office of the Navy Department, the U. S. Coast and Geodetic Survey and the Woods Hole Oceanographic Institution. These instruments include deep sea thermometers, recorders for counting minute sea-life and other recorders to test the salinity of the ocean water.

In addition to the oceanic work, the party hopes to explore most of the numerous bays and estuaries of the coast and also to make two land journeys to the crest of the Baudo-Mountain range, which is not connected with the Andean range, and from which the museum has, as yet, no birds or other animal collections.

THE ZOOLOGICAL EXPEDITION TO THE GALAPAGOS ISLANDS OF THE FIELD MUSEUM

DR. CLIFFORD GREGG, director of the Field Museum, Chicago, and Edward H. Bean, director of the Brookfield Zoological Garden, announce that the zoological expedition to the Galapagos Islands, sponsored and led by Leon Mandel, of Chicago, and conducted on board a yacht chartered by him, is on its way home with important collections for both institutions.

Approximately 2,000 specimens of fishes, birds and reptiles have been collected for the museum, as well as two live albatrosses, three frigate birds, eleven penguins, three land tortoises, a giant Barrington iguana,

[1] *Nature.*

five ground finches, a booby (bird) and a tinamou for the zoo.

In addition to fifteen islands of the Galapagos group, the expedition visited fishing grounds on the north Peruvian coast, and in the Cocos Islands near Panama. The collections for the museum include about 1,500 fishes representing some 200 different species. Included are specimens for the preparation of a habitat group of fishes to be shown in an undersea setting. There are also two sailfish less than five inches long, believed to be among the smallest specimens of this species ever taken (the mature sailfish caught by sportsmen are eight feet long, or more, and weigh upwards of 150 pounds). A twelve-foot manta (giant species of devil-fish), a 340-pound striped marlin and some fingerling dolphins are included in the fish collections. The manta, harpooned, was landed only after a long fight.

The bird collection numbers about 425 specimens, collected on different islands. Those from Galapagos are of special interest and importance, according to Karl P. Schmidt, chief curator of zoology, because the observed differences in the birds from island to island in the Galapagos group were the thing that caught Darwin's attention on his visit to these islands a hundred years ago, and formed the basis of his reasoning which led to the theory of evolution. Field Museum hopes to use the birds collected by the Mandel expedition in the preparation of an exhibit illustrating evolution.

Mr. Mandel is accompanied by Mrs. Mandel and a museum party including Dr. Wilfred H. Osgood, curator emeritus of the department of zoology; Rudyerd Boulton, curator of birds; Loren P. Woods, assistant curator of fishes; Staff Taxidermist Leon L. Walters; Melvin A. Traylor, Jr., volunteer worker in the division of birds, and Peter Lambert, of Zion, Illinois, an experienced amateur diver.

APPOINTMENTS, PROMOTIONS AND RETIREMENTS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DR. SVERRE PETTERSSEN has been appointed head of the department of meteorology at the Massachusetts Institute of Technology for the next academic year. Dr. Petterssen, who was for seven years in charge of the Weather Forecasting Institute in Bergen, Norway, and who since 1939 has been acting head of the long-established course in meteorology, which now becomes a separate department, will succeed Professor Carl-G. A. Rossby, who has been on an extended leave of absence as assistant chief of the United States Weather Bureau in charge of research. Professor Rossby will resign to join the faculty of the University of Chicago.

Faculty promotions to the rank of professor include Hoyt C. Hottel, Dr. Thomas K. Sherwood and Dr. Harold C. Weber, all of the department of chemical engineering; Dr. Ernest H. Huntress, of the department of chemistry, and Dr. Julius A. Stratton, of the department of physics.

Members of the faculty advanced to the rank of associate professor are Dr. Samuel C. Collins, Dr. Arthur R. Davis, Dr. Gerhard Dietrichson, Dr. Robert C. Hockett, Dr. Nicholas A. Milas and Charles M. Wareham, all of the department of chemistry; and Dr. Robert S. Harris and Dr. Marshall W. Jennison, of the department of biology and public health.

Promoted to the rank of assistant professor are Joseph A. Bergantz, department of chemical engineering; Dr. Alfred H. Clifford, department of mathematics; Lyman M. Dawes, Dr. Arthur E. Fitzgerald and James E. Mulligan, department of electrical engineering; Albert G. Dietz, department of building engineering and construction; John A. Hrones, department of mechanical engineering; Walter McKay, department of aeronautical engineering; Dr. Charles A. Myers, department of economics and social science; Herman J. Shea and Charles H. Norris, department of civil engineering; Walter F. Urbach, department of English and history, and James M. Austin, department of meteorology.

Appointments to the grade of instructor include Walter K. Bodger, Louis F. Coffin, Jr., Kenneth R. Fox, Frank J. Mehringer, all of the department of mechanical engineering; Robert Plunkett, of the department of electrical engineering, and Miss Margaret Whitcomb, of the department of meteorology.

Two new members of the faculty of the department of biology and public health, both of whom will be active in the program in biological engineering, are Dr. Richard Scott Bear, assistant professor in the department of chemistry at Iowa State College, and Dr. David Floyd Waugh, of the department of zoology of Washington University, St. Louis.

Lieutenant-Commander George C. Manning, who served as an associate professor in the department of naval architecture and marine engineering in 1938 and 1939, will return in the autumn as an associate professor.

Eight members of the staff will retire this year, including Charles E. Fuller, who joined the staff of the department of mechanical engineering in 1892; Professor George Owen, of Newton, internationally known yacht designer who came to the faculty of the department of naval architecture and marine engineering in 1915; Professor Arthur A. Blanchard, a member of the staff of the department of chemistry since 1899; Professor Ralph R. Lawrence, of the department of electrical engineering, who was appointed to the staff in 1896; Professor Joseph C. Riley, who has been on the staff of the department of mechanical engineering since 1898, and Professor Edward E. Bugbee, who ex-

cept for an interval of four years has been associated with the department of mining and metallurgy since 1900.

THE AMERICAN MEDICAL ASSOCIATION AND THE ANTI-TRUST LAW

ACCORDING to press reports a Federal jury on April 4 found the American Medical Association and the Medical Society of the District of Columbia guilty of Anti-Trust Law violation, but acquitted eighteen individual defendants in the case. The jury deliberated about eleven hours.

The government charged that the two organizations and the individual physicians entered into a conspiracy in restraint of trade and interfered with operations of the Group Health Association, a cooperative organization giving medical service to government employes for a monthly advance fee.

Defense attorneys contended that the practice of medicine was not a "trade," as defined in the Sherman Anti-Trust Act. Defense witnesses testified that they did not act in conspiracy in declining to cooperate with Group Health.

The original defendants in the indictment, returned in December, 1938, included the Harris County Medical Society, Texas, and the Washington Academy of Surgery, but Justice Proctor ordered their acquittals on the ground of insufficient evidence.

On April 5 the counsel for the American Medical Association announced that it would contest the verdict.

Among those acquitted are the following officers of the American Medical Association: Dr. Olin West, secretary and general manager; Dr. Morris Fishbein, editor of the *Journal* of the association; Dr. William D. Cutter, secretary of the Council on Medical Education and Hospitals; Dr. Rosco G. Leland, director of the Bureau of Medical Economics, and Dr. William C. Woodward, formerly director of the Bureau of Legal Medicine and Legislation.

SCIENTIFIC NOTES AND NEWS

THE American Academy of Arts and Sciences has awarded the Rumford gold and silver medals for 1941 to Dr. Vladimir Kosma Zworykin, director of the Research Laboratory of the Radio Corporation of America, in recognition of his work on photocells and their application, the development of television and of the electron microscope.

THE bronze medal for distinguished literature in the field of nature was presented to Louis J. Halle, who wrote "Birds Against Men," by the John Burroughs Association at the annual meeting of the association which was held at the American Museum of Natural History on March 29.

THE Wildlife Society has made its annual award for the outstanding paper of the year 1940 to Dr. Paul L. Errington, Mrs. Frances Hamerstrom and F. N. Hamerstrom, Jr., for their research bulletin on "The Great Horned Owl and Its Prey in North Central United States." The award is in the nature of an engrossed scroll and a citation in *The Journal of Wildlife Management*.

FOR his series of studies in the financing of European school systems, Dr. Fletcher Harper Swift, professor of education at the University of California at Berkeley, has been given an award of merit by the American Educational Research Association. This work was made possible through grants from the General Education Board and the Carnegie Foundation for the Advancement of Teaching.

AT the annual general meeting of the British Institute of Chemistry the Meldola Medal was awarded to Dr. Ewart Ray Herbert Jones, assistant lecturer in organic chemistry in the Imperial College of Science and Technology.

THE British Institution of Mechanical Engineers has awarded the Hawksley Gold Medal to Dr. F. D. Smith and bronze replicas of the medal to his co-authors, E. H. Lakey, H. Morgan and C. A. Luxford, for the following papers: "The Admiralty Cathode Ray Oscillograph Engine Indicator" by F. D. Smith, E. H. Lakey and H. Morgan; "Basic Principles in the Design of Cathode Ray Oscillograph Engine Indicators" by F. D. Smith and "Stress Measurement by Magnetostriction" by F. D. Smith and C. A. Luxford.

DR. RICHARD LIGHTBURN SUTTON, JR., assistant professor of dermatology at the Medical School of the University of Kansas, has been elected a fellow of the Royal Society of Edinburgh. Dr. Sutton's father, professor of dermatology at the School of Medicine, is also a fellow of the society.

AT the annual meeting on March 31 of the members of the Philadelphia College of Pharmacy and Science, Dr. Ivor Griffith, dean of pharmacy at the college, was elected to the presidency of the institution. He succeeds Dr. Wilmer Krusen, formerly director of Public Health of the City of Philadelphia, who has served as president of the college since 1927 and has been elected president emeritus.

DR. I. SCHOUR, of the Dental College of the University of Illinois, was elected to the presidency of the International Association for Dental Research at the recent St. Louis meeting. Other officers for the cur-

rent year are Dr. C. F. Bödecker, president-elect, Dr. Philip Jay, vice-president, and Dr. E. H. Hatton, secretary-treasurer.

A WIRELESS dispatch to *The New York Times,* dated from Vichy, France, April 2, reads: "Professor Paul Langevin, French physicist, who holds a Nobel prize, and Professor Paul Rivet, naturalist, are retired by order as of February 19, according to an announcement to-day in the *Journal Officiel.* They are entitled to pensions. Both were suspended early in the new régime for communistic activities."

DR. CHARLES H. BEHRE, JR., professor of economic geology and chairman of the department at Northwestern University, has been appointed professor of economic geology at Columbia University.

DR. FOLKE SKOOG, research associate at Harvard University, has been appointed assistant professor of plant physiology in the newly organized department of biology at the Johns Hopkins University, the appointment to take effect on September 1.

THE Carnegie Corporation has made a grant of $5,000 to the University of Minnesota for the continued support of investigations of viruses in relation to cell growth, conducted under the direction of Dr. Robert G. Green, professor of bacteriology at the university.

THE "Dental Science and Art" grant-in-aid of the International Association for Dental Research has been awarded to Dr. H. A. Zander to aid in the completion of his work on the penetration of silver nitrate into the tooth dentin.

OSKAR WINTERSTEINER, assistant professor of biochemistry at Columbia University, has been appointed head of the Division of Organic Chemistry at the Squibb Institute for Medical Research, New Brunswick, N. J., beginning on July 1. He takes the place of Dr. Erhard Fernholz, who had been missing since December 14 and whose body was found on March 15 in Lake Carnegie, near his home in Princeton, N. J.

GEORGE HARTNELL, for thirty-three years a magnetician in the U. S. Coast and Geodetic Survey, retired from active service on March 31. He was in charge of the magnetic observatory of the bureau at Vieques, Puerto Rico, from 1908 to 1911, and directed the work of the base magnetic observatory at Cheltenham, Md., from 1911 to 1934. For the past seven years he has devoted full time to research projects which had been planned but only partially developed during previous assignments. Some seventy-five friends of Mr. Hartnell, from the U. S. Coast and Geodetic Survey, the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and the neighborhood about Cheltenham, assembled at the observatory on his last day of service for retirement ceremonies, at which a typewriter was presented to him.

DR. LEONARD G. ROWNTREE, chief of the medical division of the Selective Service System, has announced the formation of a Medical Advisory Council the members of which will cooperate with national headquarters on problems connected with the examination of registrants. Members of the council are: Dr. Francis X. McGovern, chairman of the executive board of the Medical Society of the District of Columbia and chairman of the committee on medical preparedness of the American Medical Association; Dr. Henry C. MacAtee, past president of the Medical Society of the District of Columbia, a delegate to the American Medical Association; Dr. Thomas Stephen Cullen, professor emeritus of gynecology, the Johns Hopkins Medical School, trustee of the American Medical Association; Dr. Harvey Brinton Stone, associate professor of surgery, the Johns Hopkins University; member of the committee on medical preparedness of the American Medical Association; Dr. Robert A. Beir, secretary of the Medical Advisory Council and liaison officer between the council and national headquarters of the Selective Service System; Theodore Wiprud, executive secretary of the Medical Society of the District of Columbia and secretary to the committee on medical resources of the District Medical Society.

DR. HOWARD P. DOUB, of the Henry Ford Hospital at Detroit, has become editor of *Radiology,* succeeding Dr. Leon J. Menville, editor of the publication since 1931.

DR. GEORGE CRILE, emeritus professor of surgery at Western Reserve University, and Mrs. Crile, were passengers on the Eastern Airline plane that was wrecked in a Florida swamp shortly after leaving Miami on April 3. They suffered only minor injuries.

DR. OSCAR RIDDLE, of the research staff of the department of genetics of the Carnegie Institution, Cold Spring Harbor, N. Y., returned on March 24 from attendance at the Second Pan American Congress of Endocrinology held in Montevideo from March 5 to 8.

DR. ALFRED BLALOCK, who was recently appointed professor of surgery at the Johns Hopkins University, gave the Eastman Memorial Lecture at the School of Medicine and Dentistry of the University of Rochester on March 7. His subject was "Shock."

DR. MAX MASON, chairman of the Observatory Council of the California Institute of Technology, delivered the annual lecture before the Eta of California Chapter of Phi Beta Kappa, at the University of California at Los Angeles, on April 2. The subject

of Dr. Mason's address was "The Telescope and Our World To-day."

DR. A. C. IVY, professor of physiology and pharmacology at the Medical School of Northwestern University, will be the speaker at the annual meeting of the Chicago Academy of Sciences on April 14. His address will be entitled "The Gastro-intestinal Hormones and Their Uses."

PROFESSOR DOUGLAS JOHNSON, of Columbia University, addressed the Royal Canadian Institute, Toronto, on the evening of March 29, giving an illustrated lecture on "Topography in Relation to Military Strategy." On the same day he discussed informally with graduate students in geography at the University of Toronto, some problems of graduate instruction and on March 30 he discussed with graduate students in geology certain relations of the peace settlement of 1919 to the present conflict and future world peace.

AT the meeting of the American Association of Physical Anthropologists, held in conjunction with the fiftieth anniversary of the University of Chicago, the annual public address made after the dinner on April 7 was given by Dr. Aleš Hrdlička, of the U. S. National Museum. His subject was "Physical Characteristics of the Alaskan and Siberian Peoples."

AN Astronomical Conference on "The Fundamental Properties of the Galactic System" will be held at the New York Academy of Sciences at the American Museum of Natural History on May 2 and 3. Dr. Harlow Shapley, director of the Harvard Observatory, will preside.

A CELEBRATION of the semi-centennial of the founding of carbohydrate chemistry by the discoveries of the late Emil Fischer, German organic chemist, Nobel laureate in 1902, was held on April 10 at the St. Louis meeting of the American Chemical Society. Emil Fischer's son, Dr. Hermann O. L. Fischer, research professor of organic chemistry at the Banting Institute of the University of Toronto, was the honorary chairman of a commemoration symposium on that day. Dr. Claude S. Hudson, of the National Institute of Health, Washington, D. C., who at the opening general session of the society on April 7 received the Borden Company award of $1,000 for his work on milk sugar, was the first speaker in the symposium. He reviewed Emil Fischer's work on the configuration of glucose. The speakers included Drs. Carl F. Cori and Gerty T. Cori, of the department of pharmacology of the School of Medicine of Washington University, St. Louis, who spoke on "The Enzymatic Synthesis of Polysaccharides"; Dr. H. A. Spoehr, chairman of the division of plant biology of the Carnegie Institution of Washington at Stanford University, who spoke on "The Origin and Transformation of Carbohydrates in Plants," and Dr. Karl P. Link, of the Wisconsin Agricultural Experiment Station, whose subject was on "The Chemistry of the Hexuronic Acids."

AT the annual general meeting of the American Philosophical Society there will be on April 25 a symposium on "Recent Advances in Psychology." The subjects and speakers are as follows: "The Nature of Association," Dr. Wolfgang Köhler, professor of psychology, Swarthmore College; "Correlated Developments in Neurology and Psychology," Dr. Karl Spencer Lashley, research professor of neuropsychology, Harvard University; "The Genesis of Behavior Form in Fetus and Infant," Dr. Arnold Gesell, professor of child hygiene, Yale Graduate School, and director of the Clinic of Child Development of the Yale School of Medicine; "Mental Abilities," Dr. E. L. Thorndike, professor of educational psychology, Teachers College, Columbia University; "Psychoanalysis and the Scientific Method," Dr. Carney Landis, associate professor of psychology, Columbia University, and principal research psychologist of the New York State Psychiatric Institute and Hospital, and "Psychology and Defense," Dr. Robert M. Yerkes, professor of psychobiology, Yale School of Medicine. The Penrose Lecture will be delivered in the evening by Dr. Edward C. Tolman, professor of psychology at the University of California, who will speak on "Motivation, Learning and Adjustment."

IN the footnote to the article entitled "Dr. Dayton C. Miller and the Popularization of Science" printed in the issue of SCIENCE for April 4, page 319, the institution in which Dr. H. W. Mountcastle is professor should have been given as Western Researve University.

DR. CHARLES L. PARSONS, secretary of the American Chemical Society writes: "In making up the account of the American Chemical Society awards which you did for printing on page 299 of the March 28 issue of SCIENCE, an error occurred which perhaps is not strange unless you have a definite understanding of our procedure. Our Nominating Committee, so-called, for the Eli Lilly and Borden Awards, indeed all of our awards, do not in any way choose the recipients of the prizes. This is done by a definite Award Committee, which in the case of the Borden Award consisted of Drs. F. A. Gortner, J. H. Northrop, R. J. Anderson, E. V. McCollum, F. C. Blanck and Edwin Sutermeister; and for the Eli Lilly Award, Drs. Vincent du Vigneaud, Paul E. Howe, William C. Rose, M. B. Visscher, Wm. Mansfield Clark and Edwin J. Cohn. They were the ones who chose the recipients of the awards. The duty of the Nominating Committee is simply to ask for nominations or suggestions from individuals who make these nominations as individuals and send

them to this office with the necessary accompanying data. These are turned over by me directly to the Award Committees who make the choice. The Nominating Committees themselves have no power of choice, and indeed never in the remotest way indicate preference for one individual over another."

DISCUSSION

THE DECREASE IN VASCULARITY OF HUMAN HEARTS AND KIDNEYS BETWEEN THE THIRD AND SIXTH DECADES

FOR comparison with diseased organs the vascular beds of apparently normal hearts and kidneys were studied by perfusion. A striking finding was a decrease in flow per gram per minute in the organs of people aged 45 to 60 as compared with those 18 to 32. This amounted to 22 per cent. in the hearts, 32 per cent. in the kidneys, although there was no decrease in the average weights of the organs. Minimal changes were apparent in the arteries histologically, and the roentgenograms of the injected arterial beds appeared to be normal in the older group. Reports in the literature indicate a decline of 8 per cent. or less in basal metabolic rate, basal cardiac output and in the total number of renal glomeruli between the ages of 25 and 55. Individuals usually gain weight over this part of the life span, and the average weight of the kidneys actually was 5 per cent. greater in the older group, so that the real decrease in either cardiac work or basal metabolism probably was negligible.

Special precautions were used to remove and break up rigor of the vessels, and kerosene was used for the perfusions in order to avoid the edema of the vessel walls which sets in rapidly with saline perfusions. This method yields rates of flow, at 100 mm Hg, seven to nine times higher than those previously reported for the kidney, perfused with saline, although kerosene has twice the viscosity of saline. By correcting for the effects of differences in viscosity, in perfusion of organs, and for the observed mean blood pressures of the patients, one can derive a value for "possible blood flow" from the rate of perfusion. This averages 350 ccm per minute for the hearts of young adults, 2,080 ccm for their kidneys and 1,580 ccm for the kidneys and 280 for the hearts of the older group. A report on the blood flows through kidneys of living men, calculated from diotrast clearance, contains data on 13 men aged 45 to 56 and 14, aged 18 to 32. While the authors[1] make no reference to the effect of age, the average flow for the older group is 1,100 ccm per minute, 26 per cent. less than that of the younger men (1,400 ccm).

The biologist thinks of the vascular bed as almost as plastic and adaptable as the blood volume itself. New capillaries constantly form, and even in old age vessels grow or atrophy as the need for blood varies. The development of collateral about arteries blocked by injury, and the opening up of abundant vascular channels to supply tumors are familiar phenomena, even in the aged. It is therefore surprising to find a decrease in vascularity without a corresponding decrease in bulk of tissue or in basal metabolic need of the tissue. While the significance of these observations is not clear, they suggest the possibility that vascularity depends on the maximum stress to which the tissue is occasionally subjected rather than the basal or average metabolic needs, and that in most people advancing years bring fewer and less lofty peaks in metabolic activity. However, it is possible that the observed decrease in the vascular bed is due to loss of elasticity and to narrowing of vessels for which no compensation has been made. This would mean that by fifty-five the average man in good health has been robbed by age of over one fifth the original vascular bed in two of the vital organs.

WILLIAM DOCK
STANFORD UNIVERSITY SCHOOL OF MEDICINE

[1] W. Golding, H. Chasis, H. A. Ranges and H. W. Smith, *Jour. Clin. Invest.*, 19: 739, 1940.

VOLATILITY OF N^1-ACYLSULFANILAMIDES WITH STEAM

DURING an investigation of the pharmacology of N^1-dodecanoylsulfanilamide, difficulty was encountered in recovering the compound from the feces of dogs, by extraction with various solvents followed by evaporation. It was found that the compound was volatile with steam. Enough could be steam-distilled to permit identification by a determination of the melting point.

A number of compounds of this series were dissolved or suspended in water (0.5–1.0 g in 100–200 cc) and distilled in an all-glass apparatus, the vapors being passed through an Ace filter of porosity D (average pore diameter of 10–35 microns) to prevent entrainment. The compounds were then determined quantitatively in the distillates by the diazotization method of Bratton and Marshall.[1]

Sulfanilamide and its N^1-acetyl, butyryl (butanoyl), heptanoyl and octanoyl derivatives were not measurably volatile with steam. The approximate concentrations of other N^1-sulfanilamides (in mgm per 100 cc), obtained by slow and rapid distillations, respectively, were: decanoyl (0.0) (0.13), hendecanoyl (1.6) (7.7), dodecanoyl (0.55) (0.39). The distillates of the latter

[1] *Jour. Biol. Chem.*, 128: 537, 1939.

two compounds contained considerable amounts of solid matter which probably rendered the determinations inaccurate. The tetradecanoyl and stearyl compounds also gave turbid distillates, the solubility of the solid matter being too low to permit a quantitative determination by the method used. The N^4-dodecanoyl compound showed no turbidity in the distillate and seemed to have little if any volatility with steam.

Thus it appears that N^1-acylsulfanilamides with 8 carbon atoms or fewer in the substituent group have little or no volatility with steam, while with 10–18 carbon atoms in the substituent group, the volatility is high enough to cause serious losses when extracts of biological (or other) materials containing small amounts of the drugs are heated in open vessels. Conversely, it is quite possible that small amounts can be recovered completely by steam distillation. This may offer a useful procedure for the determination of the concentrations of such compounds in body fluids, following their administration. No further work is planned in this laboratory, but we suggest that an investigation of the steam volatility of N^1- and N^4- substituted sulfanilamides may be of importance in connection with the determination of such compounds in biological materials.

WALTER C. TOBIE
ROGER D. WILLIAMS
ELLIS J. ROBINSON
AMERICAN CYANAMID COMPANY,
STAMFORD, CONN.

AVAILABILITY OF CHEMICALS NOT SOLD COMMERCIALLY

THE Chicago Branch of the American Association of Scientific Workers is considering the following project, in which it requests the cooperation of the reader.

The availability of unusual chemical compounds, pure enzyme preparations, etc., which are not obtainable from commercial sources, is often a matter of the greatest practical importance in determining the feasibility of a research project. Unless the research worker happens to know of an individual or laboratory which has such a compound, he may be forced to undertake a long and laborious synthesis or preparation which is merely incidental to the real problem he hopes to attack. At the same time there may be ample quantities of this material in other laboratories, as an incidental by-product of certain work, and for which the originator has little use.

We would like to collect information as to the existence and availability of the above materials throughout the country, and as to the needs of any investigator for specific substances. We have in mind the establishment of a central filing system where contact might be made between any qualified investigator and the individual or laboratory where the above materials might be obtained.

A canvass of local research circles has drawn forth considerable enthusiasm for the project and an almost uniform expression of opinion as to its potential value. However, from our limited contacts we are unable to estimate the extent of interest and cooperation which we might expect from the research workers of the country as a whole, or the magnitude of the practical aspects of this undertaking. We, therefore, solicit answers to the following questionnaire from individual research workers, from heads of research departments and from any other interested individuals or organizations:

(1) Do you favor the proposed effort to establish a central information agency for the above purpose?

(2) Do you now have or do you have from time to time any unusual chemical compounds or pure enzyme preparations which are not available commercially, and which you would be willing to supply either gratis or at cost to qualified research workers? Please list names of these materials if possible.

(3) What unusual chemical compounds or enzyme preparations, which are not available commercially, do you need for your work at the present time or from time to time?

If the response to this letter warrants it, the Chicago Branch of the American Association of Scientific Workers will be glad to publish an analysis of the answers it receives, defining the apparent scope and potential usefulness of this project. It will also be glad to undertake the execution of the project if the latter does not appear to be too great an undertaking for its personnel and financial resources. In the latter case, our organization will attempt to interest some other national scientific organization or foundation in the matter.

Please address your replies to the undersigned. It is suggested that the secretaries or other officers of interested scientific organizations could help a great deal by drawing this letter to the attention of their memberships and urging them to communicate with us.

SAMUEL SOSKIN,
Chairman, Committee on Rare Chemicals
MICHAEL REESE HOSPITAL,
CHICAGO, ILL.

A PROPHECY FULFILLED

ON March 1, 1941, I wrote as follows to Dr. W. S. Adams, director of Mount Wilson Observatory:

Could you send me prints showing the visual and calcium spectroheliograph appearances of the sun? The dates desired are: Aug. 18, 19 and 20, 21, 1929, or 27 days thereafter; also Dec. 4, 5 and 6, 7, 1929, or 27 days thereafter; also March 21, 22 and 23, 24, 1930, or 27 days thereafter; also July 7, 8 and 9, 10, 1930, or 27 days

thereafter; also Oct. 23, 24 and 25, 26, 1930, or 27 days thereafter. . . .

I have reason to think that such photos when compared with our results will show a very remarkably interesting sequence of events.

The occasion came out of a visit from Dr. Brian O'Brien, of the University of Rochester, who told me that he found the correlation curve for the year 1915, published in my paper "On Periodicity in Solar Variation," Smithsonian Miscellaneous Collections, Vol. 69, No. 6, 1918, to his mind the most convincing type of evidence of the fluctuation of the solar constant of radiation. As I still find many skeptics on that question, I thought it good to obtain evidence, from more recent solar constant observations, that solar variation is associated with the rotation period of the sun.

After a little search among the newly revised solar constant values soon to be published in Volume 6 of our *Annals,* I found an interval from August 1, 1929, to January 19, 1931, when the same pattern of march of solar variation persistently accompanied each of 20 successive rotations of the sun. The largest amplitude of the fluctuation, occurring about April, 1930, was a little over 0.5 per cent. The pattern was barely distinguishable in August, 1929, reached a maximum amplitude about April, 1930, and faded nearly away in December, 1930. The correlation coefficient as between day 1 and day 27 for the interval November 11, 1929, to October 5, 1930, is 45.5 ± 7.5 per cent.

I anticipated that the sudden rise of intensity which occurred after the eighteenth day of the 27-day period, as I had chosen it, would be found associated with a well-marked increase in the disturbance of the sun's visible surface. Such a change might be evidenced either by the appearance at the expected time of a new sunspot group, just advancing over the sun's limb, or by the formation or sudden growth of a sunspot group somewhere on the disk. When writing to Dr. Adams I expected that the first two days of each of the five sets I requested would show no such visible change, but the third and fourth day of each set would show that such a change occurred.

Dr. Adams kindly sent original plates of five sets of four successive direct photographs each, covering the days in question, and an extra set covering the interval 27 days later than the set beginning December 4, 1929. These plates arrived at the Smithsonian Institution on March 12. I immediately examined them, and found my prophecy fulfilled in every case. On December 6 and 7, 1929, as well as 27 days later, large groups of new spots advanced over the limb. The same recurred on March 23 and 24, 1930, although the spots were now smaller. Again on August 5 and 6, 1930, new spots advanced over the limb. On August 20 and 21, 1929, occurred a very decided increase of size of spots already well advanced towards the center of the disk. On October 25 and 26, 1930, new spots were formed and grew rapidly beyond the center of the disk.

Dr. Adams also sent spectroheliographic plates of the same dates as the direct photographs. These show the increasing activity of the sun on the dates predicted still more strikingly.

C. G. ABBOT

SMITHSONIAN INSTITUTION

SCIENTIFIC BOOKS

HUMAN AFFAIRS

Why Men Behave like Apes and Vice Versa. By EARNEST ALBERT HOOTON. xxv + 234 pp. Illus. Princeton: Princeton University Press. 1940. $3.00.

FROM this series of Princeton lectures it appears that Hooton is genuinely interested in human affairs and confident that science can alleviate our wretched state. An introductory homily labeled "Harangue" closes with these words: "The future of our species does not hang upon forms of government, economic adjustment, religious or social creeds, and purely environmental education. The future of man is dependent upon biology. We must have fewer and better men, not more morons and machines." The theme of the lectures is "the extent to which the nature of the animal organism predetermines behavior" (p. 7). In turn, the primate order, the human family as a whole, the races of man, nations and ethnic groups and the individual are searched for evidences of body-behavior relations. The conclusion finally formulated, with special reference to man, is that "his own peculiar familial heredity, the idiosyncrasies of his own organic composition, and his own adaptive ability are the principal determinants of his behavior" (p. 192).

The most stirring chapter of all, because it presents a new method and theoretical schema for the description and classification of human physiques, is that on the individual. It is concerned mostly with individual form and physical constitution; only incidentally, and in terms of temperament, with facts of behavior. In contrast with such earlier systems as those of Viola, Kretschmer, Draper and Lombroso, Sheldon's photographic method of anthropometry and his postulated endomorphic, mesomorphic and ectomorphic components of body type and their corresponding viscerotonic, somatotonic and cerebrotonic components of temperament are summarily but clearly described, and discussed with favor. Hooton's is an illuminating word-picture of the results thus far achieved by at-

tempts to distinguish significant types of human physique.

"Why Men Behave like Apes and Vice Versa" has given the reviewer many hearty laughs. It has also caused him some groans. But even when disagreeing with the author as to fact or interpretation, inference or expectation, I find myself generally in sympathy with his point of view and manifest purpose. The style and method of presentation are unusual. Humor, irony, wit tend to compensate for iconoclasm and seemingly uncalled-for depreciativeness. Thus of biology, "On the whole, however, the apathy of biologists toward the study of the human organism is profound and general" (p. 195), or "of psychology—a science which seemingly measures its advance terminologically —by substituting, for example, the word 'drive' for the word 'instinct'" (p. 7).

This review may not be primarily a summary of the Hooton lectures, for they in themselves constitute a survey of certain areas of biology. It should then serve instead to steer the reader either to or away from the volume. If consulted as to whether it may be considered indispensable reading, I should unhesitatingly recommend it. The content of the lectures is stirring, thought-provoking, and most readers will finish the volume with feelings of appreciation and gratitude.

ROBERT M. YERKES

YALE UNIVERSITY

BIOLOGY

Biology. By HOWARD M. PARSHLEY. ix + 232 pp. 80 figs. New York: John Wiley and Sons. 1940. $1.75.

MAN'S life is, or should be, a well-rounded existence, lived not in categories, but composed of many activities, completely interwrought, each affecting the others. So often, though, in his thoughts, as reflected in the books that he writes, his penchant for orderliness takes precedence over the broader aspects of reality, and treatises on specialized subjects result, which, admirable though they may be in other ways, suggest a two-dimensional rather than a three-dimensional world. So ingrained is this tendency that even in text-books of biology plants and animals are often considered separately, though this is not the modern trend. The present volume is an expression of this more recent philosophy, which after all comes closer to the fundamental truth.

Prepared as one text of a series, for the biological portion of a science survey course for colleges, Professor Parshley's "Biology" will take its place as a valuable addition to the literature of this field. It is an honest and successful attempt to present the subject-matter of both plant and animal sciences, sometimes side by side, but more often in its real interrelationship. At times this seems rather simple and totally natural, as in the chapters on "Protoplasm and the Cell," on "Nutrition," on "Heredity," on "Ecology" and on "Variation and Evolution." In other cases this innate similarity of zoology and botany is much less obvious, as in the chapters on "Cells and Tissues" and on the "Classification of Animals and Plants." Occasionally this treatment of animals and plants together serves to emphasize their dissimilarities. In both kingdoms the nature of reproduction is basically the same. But the flower of the seed plants is very different from the reproductive organs of a mammal, as a study of the figures presented on adjoining pages brings out forcefully.

Any modern scientific text-book must take cognizance of some, at least, of the more recent developments of research. Though the field of biology is broad, there are in this volume some six pages on vitamins and deficiency diseases, salivary gland chromosomes are illustrated, there is a paragraph on plant hormones, and the effect of x-rays, heat and radium emanations on mutation are considered—to mention just a few indications that this aspect is not neglected.

Since it is one of a series of volumes for a survey course, the book must of necessity be brief. However, its ten chapters are well written, the style is simple and direct, the illustrations are perfectly clear, neatly reproduced and well labeled; some are original, many have been judiciously chosen from various sources. A one-page appendix outlines the "Highlights of Biological History" from Hippocrates in 400 B.C. to De Vries in 1900 and the "Development of Genetics and of Vitamin and Hormone Physiology" from 1900 to date. There are carefully selected chapter bibliographies and a glossary.

With a facile pen the author has drawn the salient lines of that intricately interwoven web which constitutes the realm of life, both of animals and of plants, and in doing so he has made a fine contribution.

EDWIN B. MATZKE

COLUMBIA UNIVERSITY

REPORTS

THE NATIONAL DEFENSE RESEARCH COMMITTEE

DR. VANNEVAR BUSH, chairman of the National Defense Research Committee, has made public the list of scientific men and engineers who have accepted definite appointments to work with the committee since the release of an earlier list last October. The committee organization continues to be built deliberately to

deal most effectively with particular problems as they arise. Additional appointments are now being negotiated and will be made as rapidly as effective use can be made of additional workers in the solution of specific problems.

The list, which contains the names of 118 investigators, is as follows:

Dr. Alexander J. Allen, University of Pittsburgh
Dr. William P. Allis, Massachusetts Institute of Technology
Dr. Luis W. Alvarez, Massachusetts Institute of Technology
Dr. W. R. G. Baker, General Electric Company
Professor Wilmer L. Barrow, Massachusetts Institute of Technology
Professor F. E. Bartell, University of Michigan
Professor Paul D. Bartlett, Harvard University
Professor J. A. Bearden, the Johns Hopkins University
Charles Butt, Massachusetts Institute of Technology
Dr. Harold H. Buttner, International Telephone Development Company
Professor Roy W. Carlson, Massachusetts Institute of Technology
Dr. Thorne M. Carpenter, Carnegie Institution of Washington
Professor George L. Clark, University of Illinois
Professor William M. Clark, the Johns Hopkins University
Dr. Allan P. Colburn, University of Delaware
John P. Coleman, Massachusetts Institute of Technology
Dr. Joseph A. Becker, Bell Telephone Laboratory
Dr. Alan C. Bemis, Massachusetts Institute of Technology
Professor Arthur F. Benton, University of Virginia
Professor Richard A. Beth, Princeton University
Dr. Elmer K. Bolton, E. I. du Pont de Nemours Company
Eliot B. Bradford, National Research Council
Dr. Charles E. Braun, University of Vermont
Professor Percy W. Bridgman, Harvard University
Dr. Robert B. Brode, Carnegie Institution of Washington
Professor Anton B. Burg, University of Southern California
Professor Lee A. DuBridge, University of Rochester
Professor Jesse W. M. DuMond, National Research Council
Dr. Theodore Dunham, Jr., Carnegie Institution of Washington
Dr. V. du Vigneaud, Cornell University Medical College
Melville Eastham, General Radio Company
Dr. E. A. Eckhardt, Gulf Research and Development Company
Professor H. E. Edgerton, Massachusetts Institute of Technology
Jackson H. Cook, Massachusetts Institute of Technology
G. H. B. Davis, Standard Oil Development Company
Dr. Lewis A. Delsasso, Princeton University
Dr. J. P. Den Hartog, Harvard University
Harry Diamond, National Bureau of Standards
Professor R. G. Dickinson, California Institute of Technology
Professor T. B. Drew, Columbia University
Dr. C. K. Drinker, Harvard University
Dr. H. L. Dryden, National Bureau of Standards
Dr. Frank T. Gucker, Northwestern University
Dr. E. A. Guillemin, Massachusetts Institute of Technology
Professor William M. Hall, Massachusetts Institute of Technology
Dr. Louis P. Hammett, Columbia University
Professor Arthur C. Hardy, Massachusetts Institute of Technology
Professor William D. Harkins, University of Chicago
Dr. C. P. Haskins, Haskins Laboratories
Professor Charles R. Hauser, Duke University
Dr. Alexander Ellett, National Bureau of Standards
Professor Paul H. Emmett, the Johns Hopkins University
Professor R. D. Fay, Massachusetts Institute of Technology
Professor M. R. Fenske, Pennsylvania State College
Professor Walter M. Fife, Massachusetts Institute of Technology
Dr. Herbert S. Gasser, Rockefeller Institute
Dr. E. M. K. Geiling, University of Chicago
Dr. Ivan A. Getting, Massachusetts Institute of Technology
Professor Edwin R. Gilliland, Massachusetts Institute of Technology
A. M. Grass, Massachusetts Institute of Technology
Charles H. Greenall, Bell Telephone Laboratories
Dr. Sebastian Karrer, Consolidated Gas and Electric Co.
Dr. R. W. King, American Telephone & Telegraph Co.
Dr. Thomas Lauritsen, National Academy of Sciences
Richard B. Lawrence, Massachusetts Institute of Technology
Dr. James L. Lawson, Massachusetts Institute of Technology
Professor J. M. Lessells, Massachusetts Institute of Technology
Professor Harold Hazen, Massachusetts Institute of Technology
Joseph E. Henderson, University of Washington
W. S. Hinman, Jr., National Bureau of Standards
Garret A. Hobart III, Massachusetts Institute of Technology
W. H. T. Holden, Bell Telephone Laboratories
Dr. J. C. Holtz, Bureau of Mines
Dr. Henry G. Houghton, Jr., Massachusetts Institute of Technology
Frederick L. Hovde, University of Rochester
Dr. Herbert E. Ives, Bell Telephone Laboratories
Professor Noel C. Jamison, Northwestern University
Dr. Morton H. Kanner, Massachusetts Institute of Technology
Professor L. C. Marshall, University of California
Laurence K. Marshall, Raytheon Production Corporation

Professor R. F. Mehl, Carnegie Institute of Technology
Philip H. Miller, Massachusetts Institute of Technology
Dr. Clark B. Millikan, California Institute of Technology
Dr. Dana P. Mitchell, Columbia University
Professor G. N. Lewis, University of California
Donald G. Little, Westinghouse Electric & Manufacturing Company
Dr. Charles V. Litton, Litton Engineering Laboratory
Professor Francis W. Loomis, University of Illinois
Dr. Donald H. Loughridge, Carnegie Institution of Washington
Dr. Ernest M. Lyman, Massachusetts Institute of Technology
Dr. D. P. MacDougall, Bureau of Mines
Dr. Edwin M. McMillan, Massachusetts Institute of Technology
Professor Charles E. MacQuigg, the Ohio State University
Frank J. Malina, California Institute of Technology
Dr. Eli K. Marshall, Jr., the Johns Hopkins University
Dr. I. I. Rabi, Massachusetts Institute of Technology
Dr. William H. Radford, Massachusetts Institute of Technology
Dr. Norman F. Ramsey, Jr., Massachusetts Institute of Technology
Eugene J. Reardon, American Steel and Wire Company
Dr. Alfred N. Richards, University of Pennsylvania
Shepard Roberts, Massachusetts Institute of Technology
Dr. Alan R. Moritz, Harvard Medical School
Professor J. C. Morris, Princeton University
Professor H. Victor Neher, California Institute of Technology
Professor Jesse E. Ormondroyd, University of Michigan
Professor Robert N. Pease, Princeton University
A. P. G. Peterson, Massachusetts Institute of Technology
Professor Willis C. Pierce, University of Chicago
Henry H. Porter, Carnegie Institution of Washington
R. K. Potter, Bell Telephone Laboratories
C. A. Priest, General Electric Company
Redfield Proctor, Proctor, Vermont
Dr. Jabez C. Street, Harvard University
Dr. Lauriston S. Taylor, Bureau of Standards
Arthur E. Thiessen, General Radio Company
Dr. John G. Trump, Massachusetts Institute of Technology
William G. Tuller, Massachusetts Institute of Technology
Dr. Stanley N. Van Voorhis, Massachusetts Institute of Technology
Dr. Walter van B. Roberts, Radio Corporation of America
Dr. Victor L. Ronci, Bell Telephone Laboratories
W. J. Rooney, Carnegie Institution of Washington
Dr. Otto H. A. Schmitt, University of Minnesota
Dr. J. K. Senior, University of Chicago
Dr. Charles H. Shaw, the Johns Hopkins University
Dr. S. J. Simmons, Massachusetts Institute of Technology
Dr. John C. Slater, Massachusetts Institute of Technology
Professor C. R. Soderburg, Massachusetts Institute of Technology
Dr. George R. Stibitz, Bell Telephone Laboratories
Professor Bradley Stoughton, Lehigh University
Dr. Julius A. Stratton, Massachusetts Institute of Technology
Dr. Theodor von Kármán, California Institute of Technology
Dr. John von Neumann, Princeton University
Professor Earnest C. Watson, California Institute of Technology
Professor Milton G. White, Massachusetts Institute of Technology
Professor Norbert Wiener, Massachusetts Institute of Technology
D. B. Williams, Carbide and Carbon Chemicals Co.
Professor Robert S. Williams, Massachusetts Institute of Technology
Dr. Robert R. Wilson, Massachusetts Institute of Technology
Professor Louis F. Woodruff, Massachusetts Institute of Technology
Mr. Carlton A. Woodward, Jr., General Radio Company
Professor Thomas F. Young, University of Chicago
J. C. Zimmer, Standard Oil Development Co.

The statement of October 31, 1940, which the present list supplements, contains the names of 151 scientific men and engineers who had accepted appointment with the committee prior to that date. In addition to the persons named in the two lists, there are many investigators working on projects initiated by the National Defense Research Committee, but whose names are not listed because they are not working with the committee directly.

The task assigned to the National Defense Research Committee by the Council of National Defense is that of correlating and supporting scientific research on mechanisms and devices of warfare. It does not extend to such materials as food, medicine and health. For that reason the men selected to aid the committee will continue to be drawn largely from the fields of chemistry, physics and engineering.

SPECIAL ARTICLES

SAPROPHYTES ANTAGONISTIC TO PHYTOPATHOGENIC AND OTHER MICROORGANISMS

RECENTLY, bacteriologists have given considerable attention to the phenomenon of bacterial antagonism, especially in relation to pathogenic microorganisms. Dubos[1, 2] and Sickles and Shaw[3] isolated soil micro-

[1] Rene J. Dubos, *Jour. Exp. Med.*, 70: 1–17, 1939.

ganisms capable of lyzing Gram-positive bacteria, hile Krasilnikov and Koreniako[4] found actinomycetes roducing bactericidal substances against acid-fast and ram-positive bacteria. During the past five years, e senior writer has isolated a number of bacterial ecies which are antagonistic to phytopathogenic icroorganisms in varying degrees. Special attention as given to two soil bacteria which showed a strong ntagonism both to bacteria (Gram-positive and ram-negative) and to certain fungi. One of these rganisms was identified as *Bacillus vulgatus,* while e second one, a yellow spore-bearing bacillus, re-ains unidentified. The antagonism was tested on arious solid and liquid media. On the solid media, sterile zone was formed around the giant colony of e antagonist, while the liquid media into which a sceptible microorganism was introduced was usually mpletely cleared after 1 to 3 days, depending upon e organism used and the age of the culture. The two ntagonists were active against the following phyto-thogenic bacteria: *Erwinia amylovora, E. aroidae, . carotovora, E. phytophthora, Phytomonas campes-ris, Ph. flaccumfaciens, Ph. insidiosa, Ph. juglandis, Ph. lachrymans, Ph. malvacearum, Ph. michiganensis, Ph. panici, Ph. pisi, Ph. sepedonica, Ph. stewarti* and *Ph. tumefaciens.* Of the fungi the following were ffected by the antagonists: *Fusarium graminearum, F. lycopersici, Dematophora necatrix, Helmintho-sporium sativum, Verticillium albo-atrum* and *Phy-tophthora* sp. Other microorganisms tested with similar results were *Escherichia coli, Salmonella pul-orum, S. typhi, Alkaligenes faecalis, Corynebacterium iphtheriae, Staphylococcus aureus, Streptococcus lac-is, Mycobacterium phlei, M.* sp. (Grassberger's butter acillus), 2 unidentified *Mycobacterium* sp. from the oil, *Leuconostoc mesenterioides* and *Lactobacillus cidophilus.*

The bactericides produced by the antagonists are ater soluble and active in extremely small amounts. he bactericidal substance of *Bacillus vulgatus* was dsorbed by all Berkefeld filters but passed through a hamberland L 3 filter. The bactericidal substance f the yellow antagonist was retained by both types f filters. Boiling for 60 minutes did not destroy the actericide of either antagonist. However, when the actericidal-containing medium of the yellow species as autoclaved, the bactericide was inactivated after 15 minutes at 10 pounds pressure, while that of *Bacillus vulgatus* was still active after 10 minutes sterilization at 20 pounds pressure. The strongest antagonism was observed in media containing dextrose and fructose, while no antagonism could be obtained either on a peptone sugar-free medium or in a nutrient medium plus maltose. Apparently the hydrogen-ion concentration did not affect the activity of the antagonists, since good sterile zones were obtained in media ranging from pH 4 to 10. All attempts to precipitate the active principle from culture solution with the aid of inorganic acids, ammonium sulfate, aluminum sulfate, aluminum nitrate, alcohols and ether, were unsuccessful. Bactericidal material of the culture media in which the antagonists grew can be concentrated by evaporating to dryness in a double boiler. Further studies on this phase of the problem are in progress. A more detailed report on the organisms discussed herewith and their relation to diseases will be published at a later date. Any one interested in these microorganisms may procure cultures gratis from the writers.

P. A. ARK
MARJORIE L. HUNT

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[2] Rene J. Dubos and Carlo Cattaneo, *Jour. Exp. Med.,* 0: 249–256, 1939.

[3] Grace M. Sickles and Myrtle Shaw, *Jour. Bact.,* 28: 15–431, 1934.

[4] N. A. Krasilnikov and A. I. Koreniako, *Microbiology,* : 673–685, 1939.

HEMOGLOBIN REGENERATION IN ANEMIC TROUT FED LIVER FRACTIONS AND FLY MAGGOTS

IN an earlier report the development of anemia in brook trout fed synthetic diets was described.[1] Trout recovered rapidly from this anemia when fed fresh beef liver. Inasmuch as a good test animal is needed for the study of the liver fractions used in treating human anemias, this phase of research with trout was extended during the past year. Through the generosity of four manufacturers, liver fractions used in the treatment of human anemia were provided.

About 400 trout averaging 9 grams in weight were made anemic by feeding them a diet of casein 20, starch 34, dextrin 34, yeast 5, cod liver oil 3 and Osborne and Mendel's salt mixture 4. When the red cell count had dropped to 850,000, the trout were divided into groups. The liver fractions were then weighed into capsules and fed to the trout individually. In addition to the groups fed the liver fractions, three others were used, one with no supplement, one fed fresh beef liver and one fed maggots of the common house fly. These larvae were reared upon the usual mixture of alfalfa leaf meal, bran, malt and yeast.

[1] A. V. Tunison, A. M. Phillips, C. M. McCay, C. R. Mitchell and E. O. Rodgers. Cortland Hatchery Report No. 8, for the Year 1939. New York State Conservation Department, Albany, N. Y.

Three trout were killed from each group at regular intervals and erythrocyte counts made in duplicate. The results are summarized in Table 1.

TABLE 1

Diet no.	Extract fed	Average of 6 counts in thousands at end of: 4 weeks	6 weeks	8 weeks	13 weeks
466	Fresh beef liver	973	1,051	1,130	1,120
467	Chappel's secondary	866	960	1,014	....*
468	Chappel's P.A. fraction ..	861	851	1,025	1,010
469	Chappel's whole extract .	871	875	930	1,040
470	Armour whole dried liver	840	926	978	1,040
471	Lilly	820	901	993	1,040
472	Squibb	823	830	933	978
473	No supplement	671	651	656	660
474	Fly maggots	886	1,056	1,020	1,290

* Diet discontinued because of insufficient fish.

All liver fractions permitted the regeneration of erythrocytes, but none were as potent as the larvae. These must be very rich in the anti-anemic factor. In 1937 Trager[2] reported that both house fly maggots and liver were rich in a substance essential for the growth of mosquito larvae. Furthermore, his data indicated that one factor essential for the growth of mosquito larvae seemed to be involved in pernicious anemia, inasmuch as the urine of those suffering from this disease lacked the essential while normal urine contained it.

The factor needed for the regeneration of trout blood may also be similar to that found essential for chickens[3] and pigeons[4] by Hogan and his associates.

A. M. PHILLIPS
CLIVE M. MCCAY
N. Y. STATE CONSERVATION DEPARTMENT
CORNELL UNIVERSITY

A NOTE ON SERUM CHOLINESTERASE VARIABILITY IN MALE AND FEMALE RATS

DURING the course of an experiment involving the determination of cholinesterase in rat sera, it was observed that a large number of them displayed little or no activity. It was noted that the sex of the mature animals was the factor which determined whether the cholinesterase was high or low. In a group of 74 mature rats, all the male sera (41) showed little or no activity. All the female sera, with the exception of four, were relatively very active.

These exceptions suggested the possibility that the degree of sexual maturity of the females influenced the activity of serum cholinesterase, a point which was next investigated. Sera from thirteen immature female rats (50–80 g) were examined and found to possess a very low cholinesterase activity, similar to that of the normal males. Of five old and supposedly senile female rats, three had a low serum cholinesterase activity (in the normal male range) and two displayed the high activity characteristic of the normal mature female. Despite the fact that histological examination of the ovaries of all five of these animals revealed the presence of developing ova, the cholinesterase determinations suggested that these five animals did not constitute a representative sample from the same population as the normal mature female rats.

The sera of male and female mice, examined by the Warburg manometric method,[1] show that in this species also the serum cholinesterase of the female is markedly higher than that of the male.

Although a large number of additional experiments are indicated, due to the pressure of other duties the lead can not be further investigated at this time.

EXPERIMENTAL PART

The cholinesterase determinations were carried out at pH 7.2 by the continuous titration method.[2] The titration figures were so low in the case of males and immature females that there was some doubt as to the actual presence of cholinesterase activity in these sera. By the more sensitive Warburg procedure[3] it was

TABLE I

VARIATIONS IN SERUM CHOLINESTERASE ACTIVITY WITH SEX DEVELOPMENT

	No. of animals	Range: Warburg	Range: Titrimetric	Average†: Warburg	Average†: Titrimetric
		cu. mm. CO_2	*cc*	*cu. mm. CO_2*	*cc*
Mature female rats ..	33	255– 617	0.68–2.77	415 ± 78	1.57 ± 0.51
Immature female rats ..	13	62– 160	x	107 ± 27	x
Senile (?) female rats ..	5	49– 447	x	217 ± 122	x
Mature male rats ..	41	77– 157	x	113 ± 9	x
Mature female mice .	5	1850–3000		2393 ± 325	
Mature male mice .	5	1300–2017		1545 ± 218	

x Practically all these were so low that they could not be distinguished with certainty from the blank.
† With average deviations from the mean shown.

[1] All Warburg determinations were done by H. Rudney, to whom the authors extend thanks for technical assistance.

[2] Knaffl-Lenz, *Arch. exp. Path. Pharmacol.*, 97: 242, 1923. Hall and Lucas, *Jour. Pharmacol. and Exp. Therap.*, 59: 1, 1937.

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found that such sera did possess a demonstrable activity which, however, was usually only from one fifth to one third of the values found for the sera from mature females.

Activities found by the titrimetric method are reported as cc 0.01 N acid liberated by 0.50 cc serum in 20 min.; by the Warburg method as cubic mm CO_2 liberated by 0.50 cc serum in 20 min.

In order to determine whether or not there were any activators in the mature female sera or inhibitors in the mature male sera, equal portions of these two were mixed and the activity of the mixed sera determined. The results are shown in Table II. The cholinesterase activity of the mixed sera being equal to the average activity of the component sera indicates the absence of activators or inhibitors in the female and male sera, respectively.

TABLE II

ACTIVITY OF MIXED MALE AND FEMALE SERA

Warburg method		Titrimetric method	
Calc. mean	Found	Calc. (from Warburg)	Found
272 cu. mm.	263 cu. mm.	1.22 cc	1.30 cc
283	282	1.27	1.35

SUMMARY

(1) The serum cholinesterase activity of mature female rats is three to five times as great as that found in mature male rats. Mice sera exhibit similar sexual variations in activity, but to a lesser degree.

(2) Immature female rats and probably senile female rats possess a low serum cholinesterase activity, in the same range as that of the mature male rats.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE NEW ELECTRON MICROSCOPE

THE new electron microscope that is now being manufactured by the RCA Manufacturing Company, Inc., has a simplicity and ruggedness which makes it a research tool of importance for scientific and industrial work.

The experimental predecessors of this new instrument, by virtue of their high magnifying powers, aroused the interest of research men all over the country. Magnifications as high as 100,000 opened up many new fields for research endeavor. Previous maximum useful magnification of 2,000 to 3,000 diameters placed severe limitations on such studies as particle size and shape of various materials, crystalline structures, colloidal suspensions, internal structure of bacteriological specimens, filterable viruses and many others. Much information along these lines had to be obtained from tedious and complicated indirect methods which yielded, at best, only mildly accurate results. And even these indirect methods failed to supply many of the answers. Quite often the situation was encountered where two materials were exactly alike so far as ordinary chemical analysis and observation under high power optical microscopes were concerned, yet the materials produced widely different results in actual usage. It was with the hope of solving some of these baffling problems that scientists enthusiastically welcomed the first electron microscope.

This experimental instrument did promise to be of aid. With it, particles only 50 Ångstrom units in diameter could be clearly resolved, and many new and interesting structures were observed. Such organisms as streptococci, typhoid and anthrax bacilli were not the homogeneous masses they appeared to be under ordinary microscopes, but possessed surprisingly intricate frameworks and internal compositions. Also, this electron microscope afforded a means of clearly photographing and observing some of the previously invisible filterable viruses, those tiny little agents of destruction that are so mysterious to even our most learned bacteriologists. An idea as to the importance of this may be had from glancing at the imposing list of diseases apparently caused by viruses of this sort. To name just a few—the common cold, infantile paralysis, sleeping sickness, yellow fever, and—who knows—perhaps even cancer.

However, as in most new developments, there were a few disadvantages that had to be overcome. The experimental microscope was bulky—its power supply alone occupied an entire room—it required installation in a location absolutely free from vibration and magnetic fields, and last but by no means of less importance to a prospective user, a specially trained electronic engineer was necessary for its successful operation. Obviously, these facts imposed conditions that could not be met by the average research laboratory. Their need was for an instrument that could be set on the floor of a small-sized room, plugged into a light socket and put into operation by simply throwing a switch.

The new electron microscope was designed expressly to fill this need. A microscope, power supply and all, is contained in one rack about seven feet tall and weighs approximately five hundred pounds. It fits into a corner of the room and obtains current from the normal 110-volt power line. The operator can seat himself on a chair in front of the instrument from

where he can easily reach the switches and controls (all located on the front panel of the rack) and then can look through the large eye pieces at the magnified image of the specimen under observation. At the twist of a knob, he can adjust the brightness of the image, bring it into sharp focus or vary the magnification over a wide range. He can turn another knob and adjust the position of the specimen until the most interesting portion of the field comes into view. This latter control, by the way, affords an extremely fine vernier motion by means of which the image position can be set to within a sixteenth of an inch even when the image magnification is 30,000 times. This means that the actual position of the specimen can be set to within two one-millionths of an inch!

Exposures of the image can be made on a photographic plate by simply twisting a control on the side of the instrument. The average exposure time used is about twenty seconds.

A special interlocking valve system enables specimens and photographic plates to be changed without breaking the vacuum in the entire system, thus greatly speeding up operations. Only about one minute is required for changing specimens, and approximately three minutes suffice for introducing a fresh photographic plate.

The plates are of the standard glass type used in ordinary photographic work and are ten inches long so that several exposures can be made on each plate. A control on the side of the microscope column varies the width of the electron image so that exposures of several sizes can be made.

The facility of operation of this microscope is such that as high as one hundred and fifty pictures can be taken in a single day, provided the specimens have been prepared in advance or are of such a nature as to lend themselves to ready preparation.

The power supply contains the most important improvements of all, however. No bulky transformers or filter packs are used even though a voltage of 60,000 volts is produced. Unique circuits are employed to generate this voltage and, incidentally, regulate it to better than one part in 50,000. The low voltage supplies which produce current for the condenser, objective and projection lenses are also regulated to the same degree. This stability assures good results under a wide variety of working conditions.

H. E. RHEA

RCA MANUFACTURING COMPANY, INCORPORATED

A SENSITIVE COLOR REACTION FOR 2-METHYL-1-4-NAPHTHOQUINONE AND RELATED COMPOUNDS

THE color reaction of Dam and coworkers,[1] while lacking in specificity,[2] has been useful in the investigation of vitamin K concentrates and in studies relating to its distribution, etc. Unfortunately, it is not suitable for a quantitative test because of the changing color.

We have found that the sensitivity and stability of the reaction is greatly increased when it is not based directly on the quinone, but on 2-4-dinitro-phenyl-hydrazine. This reaction can be employed for a quantitative test.

To 1 or 2 drops of a methanol or ethanol solution, containing not over 0.1 mg of 2-methyl-1-4-naphthoquinone, or related compounds, add 3 drops of a 1 per cent. solution of 2-4-dinitro-phenyl-hydrazine in 2N hydrochloric acid. Warm gently for a few seconds, cool, add 3 drops of ammonia solution (D: 0.910), shake, and then add 1 cc of amyl alcohol. A green color appears. On the addition of water the color is separated in the amyl alcohol phase. Its depth is proportional to the quinone present, and it is stable. Instead of ammonia, sodium methylate (0.5 cc of a 5 per cent. solution in methanol) can be used. In this case the color is bluish green, and it is not necessary to add amyl alcohol for its development; however, it is also soluble in this substance.

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